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# PROCEEDINGS

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## A NEW SUBSPECIES OF FLYING SQUIRREL (GLAUCOMYS SABRINUS) FROM SOUTHWESTERN UTAH

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In his Mammals of Utah, Durrant (Univ. Kansas Publs., Mus. Nat. Hist., 6: 151-153, 10 August 1952) referred all specimens of flying squirrels available to him from Utah to Glaucomys sabrinus lucifugus Hall. He studied specimens from the Uinta and Wasatch mountains in northern Utah and from the Aquarius Plateau in southern Utah. An additional record from ten miles southwest of Bryce Canyon National Park provided the extreme southwestern record of this subspecies in the state. Subsequent work by Rasmussen (Unpubl. Master's Thesis, Univ. of Utah, June, 1958) and Chamberlain (Unpubl. Master's Thesis, Univ. of Utah, March, 1958) provided specimens from the Wasatch Plateau and Fish Lake Mountains respectively, which were likewise referred to G. s. lucifugus. During the summer of 1960, in the course of a study of the mammalian fauna in southwestern Utah, a series of flying squirrels was obtained by the writer from the Tushar Mountains and the Pavant Range. Critical study of these specimens indicates that they are neither referable to G. s. lucifugus, nor to any other known subspecies, and are sufficiently distinct to warrant recognition as a new subspecies.

The writer is indebted to Seth B. Benson, Museum of Vertebrate Zoology, University of California, Berkeley, California, for the loan of comparative material and Stephen D. Durrant, Department of Zoology and Entomology, University of Utah, for his valuable suggestions and critical reading of the manuscript. The measurements of weight are in grams; all others

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are in millimeters. Unless otherwise indicated, all specimens are in the collections of the Museum of Zoology, University of Utah, Salt Lake City, Utah. Capitalized color terms are after Ridgway (Color Standards and Color Nomenclature, Washington, D. C., 1912).

#### Glaucomys sabrinus murinauralis, new subspecies

Type: Male, adult, skin and skull, no. 15652, Museum of Zoology, University of Utah; Timid Springs (SW% NE% Sec. 7, T. 29S., R. 4W.), 10,300 feet, one mile north of Big Flat Guard Station, Tushar Mountains, Beaver County, Utah; 15 August 1960; collected by Guy G. Musser; original number, 1232.

Range: Tushar Mountains and the Pavant Range in southwestern Utah, limits unknown.

Diagnosis: Based upon the type and ten paratypes (7 males, 4 females). Size: See measurements (Table 1). Color (Summer Pelage): Hairs of upper parts Sayal Brown apically, suffused with Dark Neutral Gray from basal portion; dorsal surface of gliding membrane Blackish Mouse Gray, diffused with Sayal Brown, anterior margins light gray; head lighter than body, graver; face uniformly gray; cheeks whitish, diffusing into gray in postauricular regions; ears diagnostically Mouse Gray, cranial margins and area surrounding external auditory meatus blackish; dorsal surface of forefeet between Light Mouse Gray and Mouse Gray; dorsal surface of hind feet between Mouse Gray and Deep Mouse Gray, margined laterally with white; dorsal surface of tail between Vinaceous-Buff and Avellaneous basally, diffused with grayishblack apically, producing over-all dark Fuscous tone; apical one-third of tail darkest, being uniformly Blackish Mouse Gray, darker mid-dorsal stripe uniformly indistinct; underparts between Cinnamon-Buff and Pinkish Buff, suffused with light Neutral Gray and small areas of white; ventral anterior and posterior areas of gliding membrane Light Neutral Gray; throat Light Neutral Gray diffused with whitish-buff; ventral surface of feet grayish-buff; ventral surface of tail between Vinaceous-Buff and Avellaneous.

The pelage of the tail on the four specimens from the Pavant Range is thicker and the hairs are appreciably longer than in specimens from the Tushar Mountains.

Four juveniles in immature darker pelage possess the grayer head, gray face, Mouse Gray ears and extent of venter coloration, characteristic of this subspecies.

Skull: Nasals fong, widely inflated distally, internasal suture extends caudad of frontopremaxillary suture; infraorbital foramina small; interorbital and postorbital regions narrow; braincase greatly inflated; incisive foramina short, constricted laterally so as to appear slit-like; sphenopalatine foramina large; interpterygoid space at posterior margin of palate wide, somewhat lyre-shaped; foramen ovale small; sphenopterygoid canals completely enclosed along entire length; roof of each alisphenoid canal incomplete for half its length.

Comparisons: The type and paratypes of G. s. murinauralis differ from near topotypes of Glaucomys sabrinus lucifugus, which it most closely resembles, as follows: Size: Total length averages longer; tail longer; ears longer. Color: Upper parts more yellowish-orange; head and face distinctly graver; ears graver, Mouse Gray as opposed to brown, blackish cranial margins are in contrast to dark brown of G. s. lucifugus; dorsolateral margins of gliding membrane markedly grayer; dorsal surface of tail uniformly grayer, lacking rufescence, particularly darker on apical one-third of tail, mid-dorsal tail stripe generally not as pronounced; dorsal surface of forefeet gray as opposed to brown; dorsal surface of hind feet Deep Mouse Gray as opposed to Hair Brown; dorsal surface of gliding membrane darker; hairs of underparts dominantly Pinkish Buff apically, with some whitish, as opposed to whitish apically, with area of Pinkish Buff generally reduced; throat uniformly grayer; ventral surface of feet grayer; ventral surface of tail less rufescent. Skull: Nasals average slightly longer and expanded slightly wider distally, internasal suture extends caudad of frontopremaxillary suture as opposed to terminating at level of frontopremaxillary suture; interorbital and postorbital breadths significantly less; braincase slightly more inflated; incisive foramina significantly shorter, narrower; sphenopalatine foramina generally larger; interpterygoid space at posterior border of palate significantly wider; foramen ovale smaller in seventy per cent of specimens studied; foramen magnum slightly smaller.

From near topotypes of Glaucomys sabrinus bangsi (Rhoads), the type and paratypes of G. s. murinauralis differs as follows: Size: Tail longer; hind foot averages shorter; ears longer; weight significantly less. Color (comparisons made with three specimens of G. s. bangsi in comparable pelage): Upper parts lighter, more yellowish-orange, hairs Sayal Brown in contrast to dark Wood Brown apically, hairs lighter basally; head distinctly grayer; face gray as opposed to brown; ears markedly grayer, Mouse Gray as opposed to dark brown; postauricular region whitish-gray as opposed to Avellaneous; dorsal surface of tail lighter, more yellowish-orange; dorsal surface of forefeet gray as opposed to brown; dorsal surface of hind feet Deep Mouse Gray in contrast to Clove Brown; hairs of underparts generally lighter basally, apically more Pinkish Buff than Cinnamon-Buff; ventral surface of tail grayer; ventral surface of feet gray in contrast to dark brown. Skull: Smaller in all measurements except postorbital breadth which averages slightly larger in G. s. murinauralis; nasals narrower; braincase markedly more vaulted; frontal process of zygoma higher, more pronounced; orbit smaller; sphenopalatine foramina markedly larger; foramen ovale smaller; sphenopterygoid canals completely enclosed throughout entire length as opposed to sphenopterygoid canals open medially throughout entire length except at anterior and posterior openings; roof of each alisphenoid canal incomplete for half its length in contrast to roof of each alisphenoid canal complete

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throughout entire length, terminating at anterior border of each foramen ovale; tympanic bullae smaller; foramen magnum narrower, slightly higher.

Systematic remarks: Flying squirrels of the subspecies G. s. murinauralis are apparently restricted to the Tushar Mountains and the Pavant Range. At the present time, only one specimen, a juvenile, is available from the Markagunt Plateau, the nearest highland to the south. Compared with juvenile specimens in comparable pelage from the Tushar Mountains, the specimen from the Markagunt Plateau is similar in the possession of the diagnostic Mouse Gray ears, gray face and head, and extent of venter coloration. The diagnostic cranial characters, however, are not well developed in juvenile specimens. In view of this fact and because subspecific determinations should be based on a larger sample of the population than one individual, subspecific assignment of the Markagunt Plateau specimen is tentatively held in abeyance until a series of adult specimens from the latter area is available. Acquisition and study of adult material from the Markagunt Plateau may show them to be referable to G. s. murinauralis.

G. s. murinauralis has its closest affinities both geographically and morphologically with G. s. lucifugus, the subspecies occupying the Uinta and Wasatch mountains and central high plateaus of Utah. Two specimens of G. s. lucifugus from the Fish Lake Mountains; one from Seven Mile Valley, the other from Lost Lake, demonstrate some intergradational tendencies toward G. s. murinauralis in both cranial and skin characters. The skulls of both specimens possess the characters of G. s. lucifugus except for the shorter incisive foramina and smaller foramen ovale, both characteristic of G. s. murinauralis. The specimen from Seven Mile Valley possesses dorsal coloration identical with that of G. s. murinauralis, but all other skin characters are as found in G. s. lucifugus.

Flying squirrels belonging to the subspecies G. s. lucifugus and G. s. murinauralis form a closely related subspecies complex which is markedly differentiated from those of G. s. bangsi. Study of ten near topotypes of G. s. bangsi from Idaho County, Idaho, reveals that although this subspecies is the closest geographic race to the two subspecies from Utah, it is markedly different morphologically, and close morphological relationships are not apparent. This is particularly well demonstrated in the cranial characters. Skulls of the animals belonging to the lucifugusmurinauralis complex are smaller in every measurement taken except the postorbital breadth. The greatest length of the skull is significantly longer in specimens of G. s. bangsi. This apparent shortening of the skull in the lucifugus-murinauralis group is reflected in the vertical height of the braincase, which is markedly more vaulted than in members of G. s. bangsi. The outstanding cranial differences, however, are in the arrangement of the sphenopterygoid and alisphenoid canals. In representatives of G. s. bangsi, the sphenopterygoid canals are open medially throughout their entire lengths except at the anterior and posterior openings and the roof of each alisphenoid canal is complete along its entire length, terminating at the anterior border of each foramen ovale. In those specimens of the lucifugus- murinauralis complex, however, the sphenopterygoid canals are completely enclosed throughout their entire lengths and the roof of each alisphenoid canal is incomplete, extending only halfway between the anterior opening of each canal and the anterior border of each formen ovale. In the series of flying squirrels studied by the writer, the cranial characters separating members of G. s. bangsi from those of the lucifugus-murinauralis complex are constant. Indeed, there was no specimen studied of each group which possessed any intergradational tendencies in the aforementioned characters. When Hall (Occ. papers Mus. Zool. Univ. Michigan, no. 296: 2, 2 November 1934) described G. s. lucifugus, one of the distinguishing cranial characters he found was the width of the rostrum, which expressed as a percentage in relation to the length of the nasals was less than 53 per cent of the length of the nasals. This was in contrast to G. s. bangsi in which the width of the rostrum was more than 53 per cent of the length of the nasals. Durrant (op. cit.: 153) referred a specimen from Wolf Creek Summit to G. s. lucifugus, although it suggested an intergradational tendency towards G. s. bangsi in that the width of the rostrum was slightly over 53 per cent of the length of the nasals. The writer has found that this percentage as a comparative value is inconsistent and unreliable. Percentages computed on the width of the rostrum to the length of the nasals on ten near topotypes of G. s. bangsi reveal that only two specimens exceed 53 per cent, the remainder being less than 53 per cent; on eleven near topotypes of G. s. lucifugus, three specimens exceed 53 per cent and eight are less; on eleven specimens of G. s. murinauralis, two specimens exceed 53 per cent. There is no doubt that the width of the rostrum is greater in specimens of G. s. bangsi than in those of the lucifugus-murinauralis complex, but because the nasals are also longer in the former, the percentage value as a distinguishing character is invalid.

Habitat: On the Tushar Mountains, flying squirrels were taken in Engelmann spruce (Picea engelmanni [Parry] Engelm.) from elevations of 7,875 feet to 10,300 feet. Those from the Pavant Range were trapped in stream-bottom stands of white fir (Abies concolor [Gordon and Glendinning] Hoopes) interspersed with narrowleaf cottonwood (Populus angustifolia James) at an elevation of 6,800 feet. On both the Tushar Mountains and Pavant Range, trapping in stands containing only cottonwoods or aspen (Populus tremuloides Michx.) proved unsuccessful. At 7,975 feet on the Tushar Mountains, rat snap traps were nailed to both spruce and aspen trees which existed together at this locality. A flying squirrel was taken from the spruce only. On the Pavant Range where white fir and narrowleaf cottonwoods were found in association, the former tended to be concentrated higher on the canyon slopes, the latter below and along the stream banks. Here, flying squirrels were taken in the white fir, although one individual was seen ascending a cottonwood. The largest single population of these animals observed was in Engelmann spruce at 10,300 feet on the Tushar Mountains. These data sug-

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gest that flying squirrels on these two highlands prefer a habitat in which conifers are the dominant trees. It is suspected that the source of food coupled with the rough texture of the bark on conifers are probably important factors in the selection of this habitat.

On both the Tushar Mountains and Pavant Range, flying squirrels appear to show a decided affinity for camp grounds and picnic areas when such areas are located in suitable habitat. This statement is based upon trapping results. Although suitable habitat was trapped in locations far removed from camping and picnic areas, flying squirrels were taken only at these latter areas. Open garbage pits and refuse left by campers and picnickers in coniferous areas are great attractions as a food source not only to flying squirrels but to other sciurids as well. In observing the nocturnal activity of flying squirrels (using artificial light), several were seen foraging in garbage pits, around garbage cans, and on picnic tables. One individual was seen ascending a spruce tree with a slice of bread in its mouth, while another was seen feeding on the remains of discarded corn cobs. Analyses of stomach samples from four individuals taken at a picnic area on the Tushar Mountains revealed only unidentifiable

MEASUREMENT	nª	$\bar{x} \pm 2 \text{ s.e.}^{b}$	S.D. <sup>e</sup>	EXTREMES
Total length	12	$328.8 \pm 3.4$	5.9	318 –338
Tail length	12	$156.7 \pm 3.2$	5.6	148 -167
Hind foot	12	$40.2 \pm 1.3$	2.3	34 - 43
Height of ear	12	$27.5 \pm 0.8$	1.4	25 - 30
Weight	11	$133.9 \pm 3.8$	6.2	126 -146
Greatest length				
of skull	10	$40.0 \pm 0.3$	0.6	39.1 - 40.1
Zygomatic breadth	11	$24.1 \pm 0.1$	0.4	23.7 - 24.4
Mastoid breadth	10	$18.3 \pm 0.1$	0.1	18.0- 18.5
Interorbital				
breadth	11	$7.4 \pm 0.1$	0.2	7.1- 7.7
Postorbital breadth	n 11	$8.9 \pm 0.2$	0.4	8.4- 9.4
Length of nasals	11	$12.5 \pm 0.2$	0.4	12.0- 13.5
Breadth of rostrum	n 11	$6.4 \pm 0.1$	0.1	6.2- 6.5
Toothrow	11	$8.2 \pm 0.4$	0.4	7.1- 8.6
Length of incisive				
foramina	11	$2.2 \pm 0.1$	0.2	2.0- 2.6
Interpterygoid				
widthd	11	$3.9 \pm 0.1$	0.1	3.7- 4.1
	-			

TABLE 1.—Measurements of the Type and Paratypes of *Glaucomys* sabrinus murinauralis from the Tushar Mountains and Pavant Range

<sup>a</sup> Size of sample.

<sup>b</sup> The mean and standard error of the mean.

<sup>c</sup> Standard deviation.

d Taken at posterior margin of palatines.

amorphous vegetable matter, suggestive of ingested refuse from this area.

The Tushar Mountains and Pavant Range are separated from the central high plateaus to the east by the semi-arid Sevier River Valley, and from the Markagunt Plateau to the south by intervening foothills and semi-arid valleys. At the present time, the intervening valleys serve as effective barriers in the distribution of coniferous habitat on the Tushar and Pavant highlands. The isolation of coniferous areas has in turn served as an isolating mechanism to the populations of flying squirrels on these highlands apparently dependent upon this type of habitat.

Specimens examined: Total 17, distributed as follows: MILLARD COUNTY: Pistol-Rock Picnic Area, Fillmore Canyon, 8 miles E Fillmore, 6,800 feet, Pavant Range, 1; Balsam Picnic Area, Fillmore Canyon, 8 miles E Fillmore, 6,800 feet, Pavant Range, 1; Buckskin Charley Picnic Area, Fillmore Canyon, 8 miles E Fillmore, Pavant Range, 2; BEAVER COUNTY: Indian Creek Guard Station, 9 miles E Highway 91, 7,875 feet, Tushar Mountains, 1; Kent's Lake, 8,800 feet, Tushar Mountains, 1; conifers behind M.I.A. cabin, Britts Meadow (Delano Ranger Station), 8,850 feet, Tushar Mountains, 1; Timid Springs, 1 mile N Big Flat Guard Station, 10,300 feet, Tushar Mountains, 10.